

Design of LHC Schottky Pickup

Ding Sun

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Design of pickup structure

A slotted waveguide Schottky pickup [1] has been designed for LHC. The design goal of this Schottky pickup is to achieve high sensitivity, accurate center frequency (4.8 GHz) and 200 MHz band width. Shown in Figure 1 is a schematic drawing of the pickup consisting of beam pipe, top and bottom waveguides, mode launchers (waveguide to coax adapters) and slots cut through metal foils between beam pipe and waveguides. Listed in Table 1 are the parameters of this pickup. Shown in Figure 2 is designed performance (plot of square root of forward impedance versus frequency). The frequency of peak impedance is at 4.802 GHz for difference mode and 4.908 GHz for sum mode.

Major parts of the pickup (beam pipe, waveguide and slotted foil) will be made of OFHC copper to avoid possible electron cloud generated by interaction between beam and surrounding structure.

Because the pickup will be baked at about 300 C, Teflon is not allowed to be part of any component used inside the vacuum tank. For this reason mode launchers (waveguide to coaxial adapter) and rf vacuum feedthroughs are made from commercial feedthroughs using ceramic disks as hermetic seal as well as mechanical support of inner conductor. Similarly silicon dioxide filled coaxial cables are used.

Design and measurement of mode launcher

As explained before, in order to meet the stringent vacuum requirement and the time schedule, a CERN approved rf feedthrough made by Kyocera Inc. (part name: SMA-R with CF16) is modified and converted into a mode launcher. A stainless steel cylinder is attached to this feedthrough. Shown in Figure 3 is a 3-D schematic drawing of this mode launcher mounted on a waveguide. The blue part is the attached cylinder. The critical parameters of this mode launcher are shown in Figure 4.

Shown in Figure 5 is the measured S parameter of this launcher. The return loss is ~ -40 db around 4.7 – 4.8 GHz. The return loss is less than -20 db from 3.95 GHz to 5.35 GHz.

Mechanical drawings

All dimension details of this pickup can be found in Fermilab mechanical department drawing set: LHC_schottky (starting from drawing number #1770.100-MD-446082).

References

[1] D. McGinnis, "Slotted Waveguide Slow-wave Stochastic Cooling Arrays," P-bar Note 626, 1999

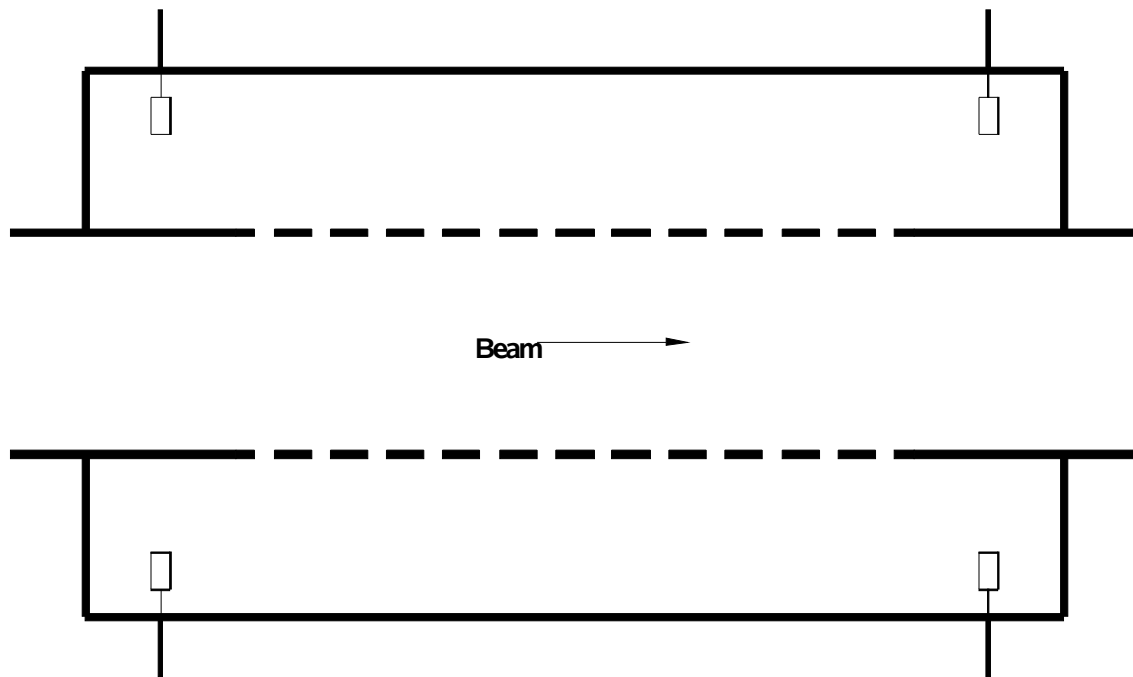


Figure 1. Schematic drawing of Schottky pickup

Table 1. Parameters of LHC Schottky Pickup (unit: mm)

Slot length	Slot width	Slot Spacing	Number of Slots	Waveguide width	Waveguide height	Beam pipe width	Beam pipe height
20.52	2.032	2.032	246	47.549	22.149	60.00	60.00

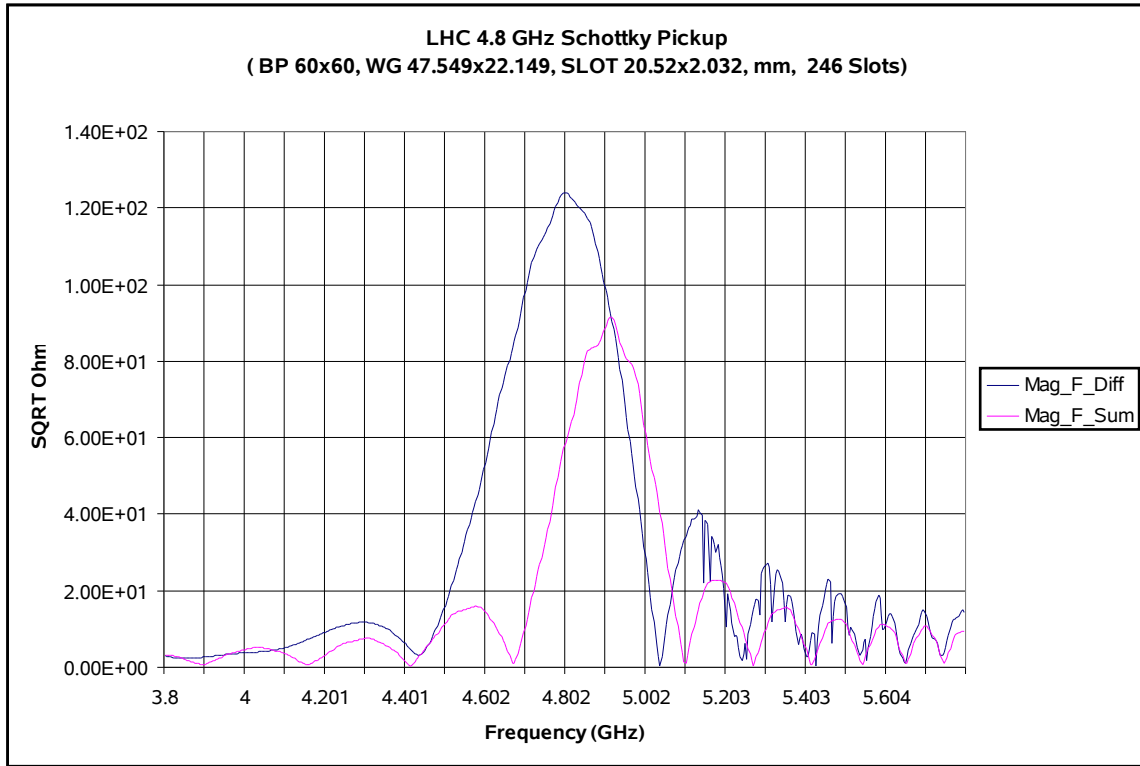


Figure 2. Impedance of LHC Schottky pickup

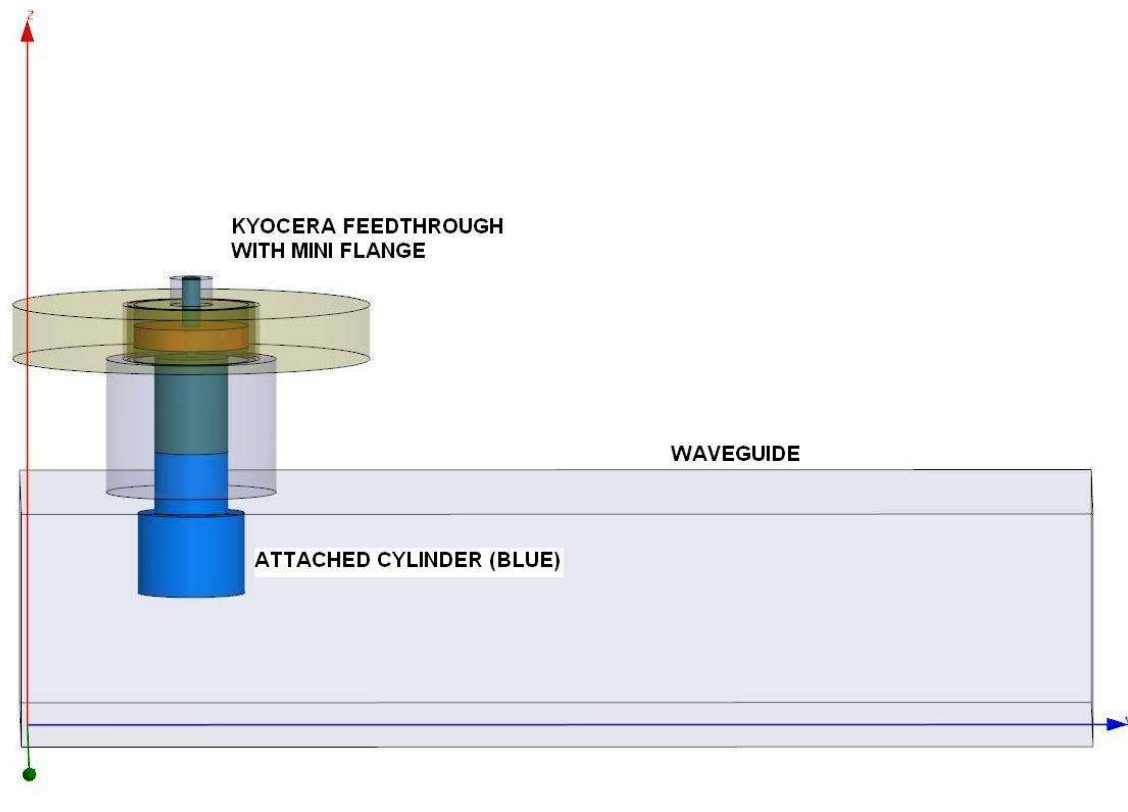


Figure 3. Mode launcher (waveguide – coax adapter) of LHC Schottky pickup

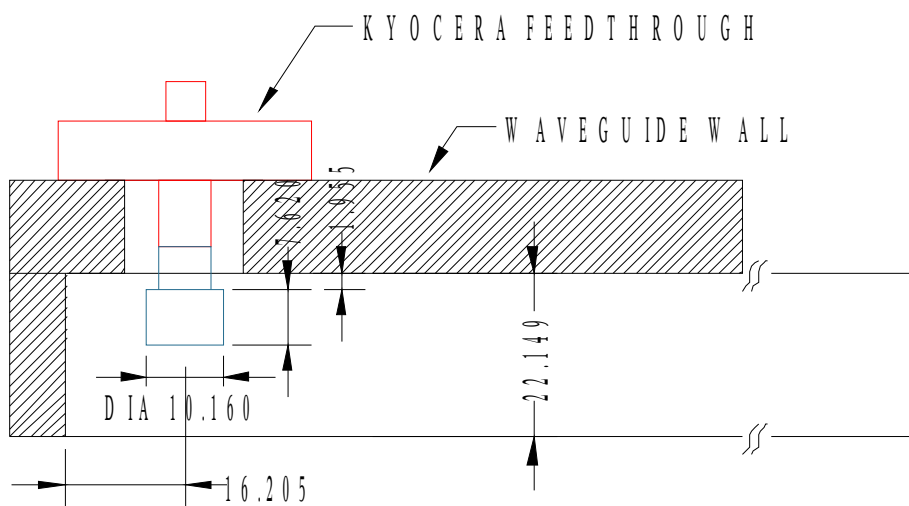


Figure 4. Parameter of mode launcher (unit: mm)

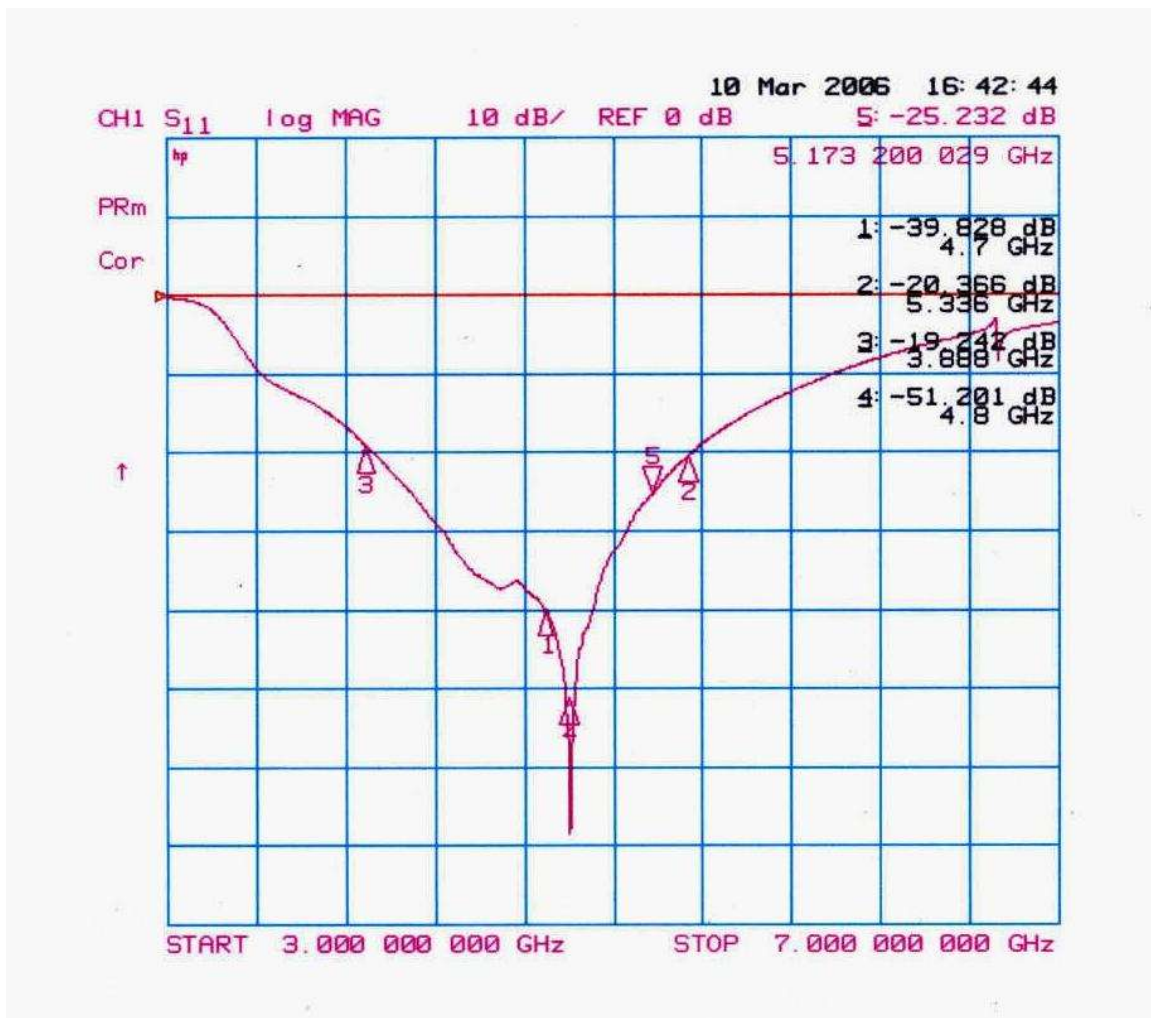


Figure 5. Measured S parameter (S₁₁) of mode launcher